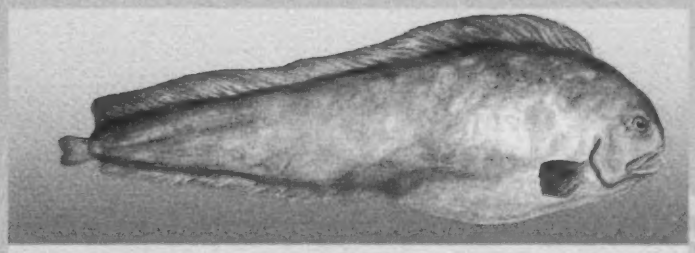
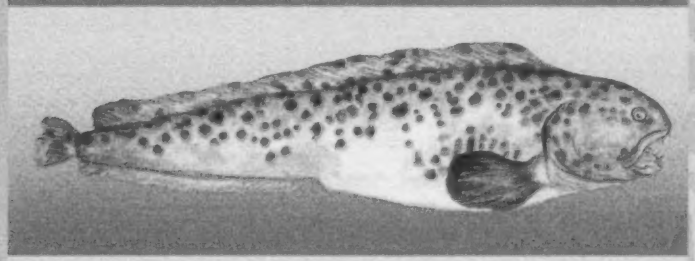
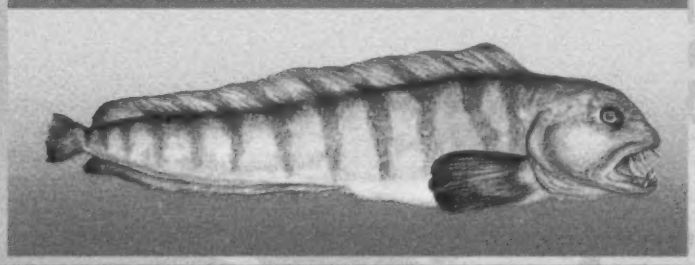
Species at Risk Act
Recovery Strategy Report Series

Report on the Progress of Implementation of the Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada for the Period 2008-2013

Northern Wolffish, Spotted Wolffish and Atlantic Wolffish







2013

Canada

Report on the Progress of Implementation of the Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada for the Period 2008-2013.

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PREFACE

Sections 46 and 72 of the *Species at Risk Act* (SARA) requires the competent Minister to report on the implementation of the Recovery Strategy or Management Plan for a species at risk, and on the progress towards meeting its objectives within five years of the date when the Recovery Strategy or Management Plan was placed on the Species at Risk Public Registry.

Reporting on the progress of Recovery Strategy or Management Plan implementation requires reporting on the collective efforts of the competent Minister, provincial organizations and all other parties involved in conducting activities that contribute towards the species' recovery.

EXECUTIVE SUMMARY

The *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus), Spotted Wolffish (A. minor), and Management Plan for Atlantic Wolffish (A. lupus) in Canada* (Kulka *et al.* 2007) (hereafter referred to as the Recovery Strategy) was posted on the Species at Risk Public Registry in 2008. The following document fulfills Fisheries and Oceans Canada's (DFO) commitment to report every five years on the progress of Recovery Strategy implementation and covers the period February 2008 - February 2013.

The Recovery Strategy is presently being updated using current data and information. Critical habitat of wolffish was not identified in the original Recovery Strategy. However, critical habitat of Northern and Spotted Wolffish in the Gulf of St. Lawrence and Newfoundland and Labrador waters has since been established. This critical habitat will be included in the updated Recovery Strategy.

The status of all three wolffish species in Canada was re-assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2012. Although there are signs of population recovery, COSEWIC recommended that all designations remain unchanged as the species' remain at low abundance compared to historic levels (COSEWIC 2013a,b,c). Therefore, under the *Species at Risk Act* (SARA), the status for Northern and Spotted Wolffish will remain as Threatened and the status for Atlantic Wolffish will remain as Special Concern.

Under SARA, a Recovery Strategy and corresponding Action Plan must be prepared for species designated as Endangered, Threatened or Extirpated. The completion of an Action Plan for Northern and Spotted Wolffish by DFO in 2013 will fulfill this requirement.

The Recovery Strategy identified five Recovery Objectives: 1) enhance knowledge of the biology and life history of wolffish species; 2) identify, conserve and /or protect wolffish habitat required for viable population sizes and densities; 3) reduce the potential of wolffish population declines by mitigating human impacts; 4) promote wolffish population growth and recovery; and 5) develop communication and education programs to promote the conservation and recovery of wolffish populations.

Much progress has been made towards fulfilling Recovery Objectives 1 through 5. Several aspects of wolffish life history have been studied including food and feeding, population structure, and effects of dissolved oxygen on growth. Distribution and abundance has been examined for all regions and large scale habitat associations have been described. Bycatch was identified as a cause of human induced mortality of wolffish and mandatory release of Northern and Spotted Wolffish was implemented. In addition, management and stewardship activities have increased awareness of wolffish and their status.

Large scale collecting of habitat data will continue through DFO Research Vessel (RV) and other surveys, while a finer scale focus on habitat through acoustic tagging, as well as direct observation using SCUBA and towed cameras, will be enhanced. Ongoing research on distribution, abundance, population structure, and life history will continue. An increase in education and stewardship activities aimed toward fish harvesters, as well as a review of

observer logbooks and reports, is needed to improve reporting of wolffish species. A re-evaluation of allowable harm should also be completed. Ongoing bycatch reduction initiatives and management and stewardship activities will continue.

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1. BACKGROUND

1.1 COSEWIC Assessment Summary

1.1.1 Species Information: Northern Wolffish

Common Name:	Northern Wolffish, Broadhead Wolffish, Bullheaded Wolffish, Catfish
Scientific Name:	*Anarhichas denticulatus*
Status:	Threatened (SARA Schedule 1)
Reason for Designation:	This species underwent strong declines in both abundance and in range size during the 1980s. For the next decade there was little change, but since about 2002 there have been small increases in both range size and abundance. These have been in parallel with recovery measures, including mandatory release of individuals taken as bycatch. While these recent increases are encouraging, the species is still at very low levels compared with the beginning of research surveys in the 1970s. Although there has been a general decrease in the level of fishing over its range, its recovery may still be limited by bycatch in fisheries in the deep waters in which it occurs (COSEWIC 2013a).
Canadian Occurrence:	Arctic Ocean, North Atlantic Ocean
Status History:	Designated Threatened in May 2001. Status re-examined and confirmed in November 2012.

1.1.2 Species Information: Spotted Wolffish

Common Name:	Spotted Wolffish, Leopardfish, Catfish
Scientific Name:	*Anarhichas minor*
Status:	Threatened (SARA Schedule 1)
Reason for Designation:	This species underwent strong declines from the late 1970s until the mid-1990s, but since then there has been some recovery over most of its Canadian range. This is indicated by both increases in abundance and area of occupancy. These increases parallel a reduction in bottom fisheries that had a high incidental catch of this species, as well as introduction of recovery measures including mandatory release. While these recent increases are encouraging, the species is still at low levels compared with the beginning of the research surveys (COSEWIC 2013b).
Canadian Occurrence:	Arctic Ocean, North Atlantic Ocean
Status History:	Designated Threatened in May 2001. Status re-examined and confirmed in November 2012.

1.1.3 Species Information: Atlantic Wolffish

Common Name:	Atlantic Wolffish, Striped Wolffish, Catfish
Scientific Name:	*Anarhichas lupus*
Status:	Special Concern (SARA Schedule 1)
Reason for Designation:	This species underwent steep declines in both abundance and area of occupancy over much of its range from the 1980s until the mid-1990s, including its historical stronghold in waters east and north of Newfoundland. Since then it has been increasing in abundance and area of occupancy. While these recent increases are encouraging, the species remains at low abundance compared to the early 1980s. Population increases have probably been aided by reduced commercial fisheries, which take wolffish as bycatch. There have been continuing declines in abundance on the Scotian Shelf and in the Southern Gulf of St. Lawrence, where historically there were fewer individuals than areas to the east and north (COSEWIC 2013c).
Canadian Occurrence:	North Atlantic Ocean
Status History:	Designated Special Concern in November 2000. Status re-examined and confirmed in November 2012.

1.2 THREATS

1.2.1 Threats to the Species at Risk

The following is a list of actual and potential threats as identified for wolffish.

Fishing
There has been no directed fishery for wolffish in Canadian waters. However, bycatch is thought to be the leading cause of human induced mortality. However, what proportion bycatch contributes to total mortality and to the decline of these species is unclear. Bottom trawling and dredging activities were identified as possible causes of wolffish habitat alteration.

Seismic Activities
The towed arrays of airguns used in seismic exploration can cause physical injury to fish, eggs, and larvae at close range. Physical effects on wolffish adults and eggs at depth are likely minimal. However near surface larval stages could be potentially affected.

Oil and Gas Exploration
Increasing oil and gas exploration in eastern Canadian waters increases the possibility of oil spills, offshore well blowouts, tanker spills, and other major disasters. In addition, mud and cuttings released from drilling operations can have toxic effects and smother benthic organisms near the rig site.

Sewage Sludge
Coastal dumping and pipeline discharge of sewage sludge can impact planktonic and coastal benthic communities, including toxic effects of introduced bacteria and viruses on shellfish. Effects on wolffish are unknown. However, since wolffish are widely distributed and most sewage dumping is coastal, it is likely that the impact is minimal.

Fish Waste
Large volumes of waste generated from fish processing can result in the introduction of various chemicals, disease vectors, and non-indigenous species; an increase in heterotrophic bacteria; eutrophication, oxygen depletion, and an overloading of the ecosystem.

Dredging Spoils
Sludge materials dumped by barges can have wide ranging effects depending on currents and weather patterns. These materials can affect the metabolism, diet, and composition of organisms, introduce contaminants, and smother hard bottom assemblages causing extreme changes in macrofauna and macroflora.

Cables and Pipelines
Placing cables and pipelines on the sea bottom or in the water column may have a spatially limited effect on wolffish habitat.

Marine and Land-based Pollution
Pollutants in the form of sediments, pathogens, excess nutrients, persistent toxins and oil may negatively affect habitat, reproduction, and health of wolffish.

Global Climate Change
Atmospheric changes due to climate change can alter ocean productivity, species composition, and habitat. It is currently unknown if and how climate change has been a factor in the decline of wolffish populations.

Natural Mortality
Little is known of the diseases, parasites, predators, and environmental conditions of wolffish and whether they have been a factor in the population decline.

1.2.2 Threats to Critical Habitat

Critical habitat of wolffish was not identified in the *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus), Spotted Wolffish (A. minor), and Management Plan for Atlantic Wolffish (A. lupus) in Canada* (Kulka *et al.* 2007) (hereafter referred to as the Recovery Strategy). This Recovery Strategy is presently being updated and will include critical habitat and a description of threats.

2. RECOVERY

2.1 Recovery Goals and Objectives

2.1.1 Recovery and Management Goals

The goal of the Recovery Strategy is to increase the population levels and distribution of Northern, Spotted and Atlantic Wolffish in eastern Canadian waters such that the long term viability of these species is achieved.

In general, the recovery of a species at risk involves a multi-faceted approach that takes into consideration individual populations, the number and nexus of these populations and the creation of adequate population levels to withstand events such as environmental shifts and climate change. As identified in the Recovery Strategy, establishing a sustainable population requires:

- enough breeding adults to be considered sustainable in the long term;
- sufficient quality habitat available or potentially available to maintain sustainable population numbers;
- adequate or improving demographic parameters (e.g., sex ratio, birth and death rates); and
- mitigation against and control of human threats to the population, particularly those that initially contributed to the species' decline.

2.1.2 Recovery and Management Objectives

Objective 1: Enhance knowledge of the biology and life history of wolffish species;

Objective 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;

Objective 3: Reduce the potential of wolffish population declines by mitigating human impacts;

Objective 4: Promote wolffish population growth and recovery; and

Objective 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations.

2.2 Performance Indicators

Performance indicators were not identified in the original Recovery Strategy. Progress in research and monitoring activities, critical habitat, management activities, and stewardship and education are discussed in Section 3.

3. PROGRESS TOWARD RECOVERY

3.1 Research/Monitoring Activities

3.1.1 Life History

The most recent information on the life history of wolffish species is available in Dutil *et al.* (2011), Simpson *et al.* (2012), DFO (2013) and Simpson *et al.* (2013a,b,c) and is summarized below. These studies represent progress on Recovery Objective 1: Enhance knowledge of the biology and life history of wolffish species.

The diet and feeding habits of all three species of wolffish in Newfoundland and Labrador continental shelf waters has been examined (Simpson *et al.* 2013c). The most important prey groups for each species were identified as pelagic and benthic fishes for Northern Wolffish, shrimp and echinoderms for Spotted Wolffish and crabs and echinoderms for Atlantic Wolffish. The relative proportions of nine prey groups and percent contribution of benthic and piscivorous diet varied significantly between species. Northern Wolffish were described as "fish specialists" (piscivores), Spotted Wolffish as "echinoderm specialists" (benthivores) and Atlantic Wolffish as "mollusc specialists" (benthivores). Diet overlap was highest between Atlantic and Spotted Wolffish and lowest between Atlantic and Northern Wolffish.

Morphometric and meristic data obtained from specimens collected during Fisheries and Oceans Canada (DFO) Newfoundland and Labrador Research Vessel (RV) surveys indicate some population structure among Northern as well as Atlantic Wolffish (Simpson *et al.* 2013b). There are possibly two distinguishable groups of Northern Wolffish; one group centered on the northern and southern Grand Banks (Northwest Atlantic Fisheries Organization (NAFO) Divisions 3NL) and the other spread over most of the northeast Newfoundland and Labrador shelves (NAFO Divisions 2J3K). For Atlantic Wolffish, one group is centered on the southern Labrador shelf (Division 2J) and the other on the southwest Grand Bank (NAFO Division 3O). Atlantic Wolffish in NAFO Divisions 3KLN and Subdivision 3Ps were not distinguishable from the other two groups. Several recent genetic studies on wolffish (Johnstone *et al.* 2007; Carr *et al.* 2008; Imsland *et al.* 2008; McCusker *et al.* 2008; and McCusker and Bentzen 2011) have been carried out to help determine population structure. Although work by Imsland *et al.* (2008), McCusker *et al.* (2008) and McCusker and Bentzen (2011) indicate some geographic variation among wolffish, genetics have provided no conclusive evidence on population structure.

In the Gulf of St. Lawrence, seabeds deeper than 175m have permanently low dissolved oxygen levels (hypoxia). In the Gulf, the Spotted Wolffish occurs less frequently at depths above 175m than in the waters of Newfoundland and Labrador, which suggests that Spotted Wolffish partially avoid hypoxic waters. In laboratory studies, at 8°C, dissolved oxygen levels were found to affect growth rates in Spotted Wolffish, with hypoxic conditions below 70% saturation producing smaller fish than normoxic (normal) conditions (>90% saturation). These studies showed that food consumption was lower in hypoxic conditions. The data suggests that digestion slows under hypoxic conditions, which reduces food consumption and growth (DFO 2013). Since some Spotted Wolffish in the Gulf of

Lawrence are exposed to hypoxic conditions, it would be useful to study whether their growth is below that of individuals on Newfoundland and Labrador's eastern shore. Laboratory studies on effects of varying dissolved oxygen levels on survival and the development rates of eggs and larvae would be valuable (M. Simpson, DFO, pers. comm. 2013).

Current gaps in life history knowledge include information on aging, growth and reproductive maturity patterns in wolffish. This is known for some wolffish species in other areas of the Atlantic, but little is known for wolffish in Canadian waters. Investigating these aspects of wolffish life history will help to understand the variation in the age of maturity throughout the geographic range as well as spatio-temporal variation in spawning of each species.

3.1.2 Distribution and Abundance

Research on distribution and abundance of wolffish in Arctic and eastern Canadian waters (Kulka *et al.* 2004; Dutil *et al.* 2011; Simon *et al.* 2012; Simpson *et al.* 2012; DFO 2013; Simpson *et al.* 2013a) has furthered the large scale understanding of wolffish population dynamics. Surveys are ongoing, usually on a seasonal or annual basis, thus allowing for continual updates on wolffish distribution and abundance. These studies represent progress on Recovery Objectives 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities, and 4: Promote wolffish population growth and recovery.

The following is a brief overview of distribution range and stock size for wolffish in Canadian waters. It must be noted that, due to various changes in sampling gear type, research vessels, and annual spatial coverage in the regions, survey abundance trends cannot be considered directly through the entire survey period.

DFO surveys in the Arctic region, although limited, have shown that all three species have been found in NAFO Subarea 0. They are close to the boundary of Subarea 1 (Greenland waters) and NAFO Division 2G and could possibly be extensions of the stock from these areas. As in other areas, Northern Wolffish were found in the deepest water (200-1100m), while Spotted (200-700m) and Atlantic Wolffish (200-500m) were found in more similar depth ranges. Abundances were low and area of occupancy generally remained the same over time (DFO 2013; Simpson *et al.* 2012, 2013c).

Northern and Spotted Wolffish in Newfoundland and Labrador waters are at the center of their distribution, with their highest densities and largest distribution on the northeast Newfoundland and southern Labrador shelves. DFO annual spring (1971-2012) and fall (1977-2011) surveys indicate persistent concentrations of Northern and Spotted Wolffish in an area centered north of the Grand Bank, while Atlantic Wolffish have a persistent concentration on the southern Grand Bank. The clearest trend in abundance indices for all three species has been shown in the fall surveys in NAFO Divisions 2J3K. The highest abundance was in the late 1970s when the surveys began. It declined continuously through the 1980s and early 1990s and remained low throughout the decade. All species have shown signs of stock recovery in the last decade with increases in relative abundance and distribution in most areas surveyed (Kulka *et al.* 2004; Simpson *et al.* 2012, 2013a).

Distribution of wolffish species in the northern (NAFO Divisions 4RS) and southern (NAFO Division 4T, excluding the Gulf of St. Lawrence Estuary) Gulf of St. Lawrence from 1978-2012 have been analyzed using data from various sources, including annual DFO RV surveys and annual fixed and mobile gear Sentinel Fishery Surveys[1]. Northern Wolffish are rare in the Gulf with most catches off the southwest coast of Newfoundland and a few on the slopes of the Laurentian Channel. Spotted Wolffish, are not as rare and are most commonly found in the northeastern Gulf, on the shelf off Newfoundland's west coast, and the slopes of the Esquiman Channel. Both Northern and Spotted Wolffish are practically absent in the southern Gulf. Distribution of Atlantic Wolffish is more extensive in the Gulf. They avoid deep channels and prefer the upper slopes of channels and shelves such as the shelf off Newfoundland's west coast. In general their relative occurrence is low in the southern Gulf however, they are present along the 200m isobath on the slopes south of the Laurentian Channel (Dutil *et al.* 2011). Relative occurrences for all species do not show any significant trends over time (Dutil *et al.* 2011; Simpson *et al.* 2013c).

Annual DFO summer surveys (1970-2010) on the Scotian Shelf have shown that Northern and Spotted Wolffish are near the southern limit of their range in this area. Abundance is very low with catches mainly on the eastern Scotian Shelf (NAFO Division 4V) and some along the shelf edge (NAFO Divisions 4WX). Atlantic Wolffish are found throughout Scotian Shelf/Bay of Fundy waters in two main areas on the Scotian Shelf; one on the east (NAFO Divisions 4VW) and one on the west (NAFO Division 4X, primarily Brown's Bank). Atlantic Wolffish abundance has declined since 2000 and area of occupancy has declined since the 1970s (Simon *et al.* 2012; Simpson *et al.* 2013a).

Biological Reference Points (BRP's) and abundance/biomass targets have yet to be identified for wolffish species. However, an empirical approach to determine Biomass of Maximum Sustainable Yield (B_{MSY})[2] and related BRP's, based on wolffish RV survey biomass estimates, has been proposed for consideration and further evaluation (DFO 2013).

3.1.3 Habitat

Work on habitat associations for wolffish in both Newfoundland and Labrador (Kulka *et al.* 2004; DFO 2011; Simpson *et al.* 2012) and the Gulf of St. Lawrence (Dutil *et al.* 2013a,b) has been carried out. These studies represent progress on Recovery Objectives 1: Enhance knowledge of the biology and life history of wolffish species; 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities; and 4: Promote wolffish population, growth and recovery.

The Newfoundland and Labrador annual spring and fall surveys (1971-2011) have provided information on temperature, depth and bottom preferences for all three wolffish species. Wolffish in these waters are associated with a narrow temperature range of 1.5 to 4.5°C. They are "temperature keepers" and will adjust their distribution to stay within their

[1] The Sentinel Fishery Survey is a fisheries science program in which harvesters work in collaboration with DFO Scientists to collect data on Atlantic Cod along the coast of Newfoundland and Labrador.
[2] The biomass (combined weight of all individuals) associated with MSY. MSY is the maximum use that the fishery resource can sustain without impairing its renewability through natural growth or replenishment.

preferred temperature range. During the period of low abundance (1990-1995), all species had shifted their distribution to warmer waters along the shelf edge (Kulka *et al.* 2004). Wolffish are found at a wide range of depths. Northern Wolffish are found in the deepest waters (300-1200m), Spotted Wolffish in more intermediate waters (100-800m), and Atlantic Wolffish in the shallowest waters (50-450m) (DFO 2011). Sediment types, determined from RoxAnn seabed classification data, were defined as mud, sand, sand and shell, shell and pebbles, small rock, hard bottom, or undefined. Wolffish were found on all available sediment types. However, Northern Wolffish were caught more often on sand/shell/pebbles while Spotted and Atlantic Wolffish showed no preference. Comparatively, individual scale observations of Atlantic Wolffish during inshore SCUBA dives showed that they occurred in shallow waters less than 25m, were never observed on soft bottoms and used boulders and caves for spawning (Kulka *et al.* 2004).

Gulf of St. Lawrence wolffish catch and effort data (DFO RV surveys 1971-2008) were aggregated on a hierarchical habitat classification grid (grid size = 10km X 10km) by Dutil *et al.* (2013a,b). This provided habitat data for all three species of wolffish. Northern Wolffish were strictly associated with the deep-water, steep sloped habitat. They were found mainly in poorly diversified habitats, on fine sediments, and in offshore channels, at depths greater than 200m (median of minimum and maximum depths, respectively, 210m and 320m, 280m and 350m for aggregations). Low oxygen saturation, constant temperature of 3-5°C, and high salinity (34) were also observed.

Spotted Wolffish were associated with the deep water shelf habitat, the relatively cold, shallow to mid-depth habitat, and less intensively with the deep-water, steep sloped habitat. Their habitat was more diversified but tended towards coarse sediments and rocky outcrops on shelves rather than channels. They were most abundant in a narrow temperature range (2-4°C) at intermediate levels of dissolved oxygen (mild hypoxia). They were found in shallower waters then the Northern Wolffish (median for minimum and maximum depths, respectively, 130m and 230m, 110m and 200m for aggregations)

Atlantic Wolffish were found to use three contiguous megahabitats most intensively: the deep-water steep sloped habitat, deep-water shelf habitats, and the relatively cold, shallow to mid-depth shelf habitats. Compared to the other two species, Atlantic Wolffish were found closer to shore and in more diverse habitats. They were rarely found in channels and more often associated with outcrops and coarse sand. They were at depths less than 200m, (median of minimum and maximum depths, respectively, 90m and 200m, 90m and 180m for aggregations), at salinities below 34 and temperatures below 4°C.

Most wolffish habitat data has been acquired through large scale research surveys. As a result, individual scale habitat data for all wolffish species is insufficient. Two studies (Kulka *et al.* 2004; Larocque *et al.* 2008) provided some limited habitat descriptions and investigated shelter use by Atlantic Wolffish. In situ behavioural studies on Spotted and Northern Wolffish are more difficult, as these fish tend to occupy deeper water. Laboratory behavioural studies did show the use of shelters by juvenile Spotted Wolffish which were observed spending most of their time in or near available shelters (Lachance *et al.*, 2010). Knowledge of association with other species is also very limited. However, Chouinard and Dutil (2011) have described demersal fish assemblages for the northern Gulf of St. Lawrence in which both Spotted and Atlantic Wolffish were observed. Ongoing telemetry

studies in Newfoundland and Labrador waters using acoustic tags and SCUBA to study habitat use and movement patterns are furthering this habitat research. Acoustic tags have been surgically inserted into captured wolffish and, once released, individual fish are tracked using portable acoustic receivers and hydrophone arrays. SCUBA is also used to record detailed habitat and behavioural data on individual fish. Plans are underway to potentially use towed photographic equipment in upcoming detailed studies of species habitat associations in 2013 (M. Simpson, DFO, pers. comm. 2013).

3.1.4 Mortality

There are no directed fisheries for wolffish in Canadian waters. Records of directed catches occur occasionally in landing statistics, but are likely coding errors (Kulka and Simpson 2004). Bycatch has been identified as a cause of human induced mortality and has been quantified in many fisheries (Ouellet *et al.* 2011; Simon *et al.* 2012; Simpson *et al.* 2012; DFO 2013; Simpson *et al.* 2013a). These studies represent progress toward Recovery Objectives 3: Reduce the potential of wolffish population declines by mitigating human impacts; and 4: Promote wolffish population growth and recovery.

In 1971 the reported landings of wolffish in the entire Canadian zone of interest (NAFO Divisions 0AB, 2GH, 2J3K, 3LNO, 3P, 4RST, 4VWX) peaked at 12,000 tons and then declined (DFO 2013). In 2004, an Allowable Harm Assessment was carried out for wolffish (DFO 2004a,b; Kulka and Simpson 2004). Live release of Northern and Spotted Wolffish bycatch was made mandatory when the species were listed on Schedule 1 of the *Species at Risk Act* (SARA) when the Act came into power in 2003. Northern and Spotted Wolffish must be released back into the water and only Atlantic Wolffish may be landed. This measure was implemented to address Recovery Objective 3: Reduce the potential of wolffish population declines by mitigating human impacts. Evaluation of wolffish mortality in commercial fisheries has been problematic due to unspeciated wolffish landings (except for Canadian Fisheries Observers data), misreporting of locations and species caught, and unreported discards at sea.

Atlantic Wolffish are considered a resilient species and a good survival rate of live released fish is considered likely. Fishery Observer records have shown that wolffish captured incidentally in various fisheries are very active upon release (Kulka and Simpson 2004). In a study by Grant *et al.* (2005) Atlantic Wolffish caught as bycatch in the commercial Yellowtail Flounder fishery showed high survival rates when returned to the ocean following up to 2.5 hours out of the water. Similar studies have not been conducted on Spotted or Northern Wolffish. Benoit *et al.* (2010) investigated the factors that affect pre-discard condition of wolffish (and other species) and found a correlation between body size and good condition. SARA logbook data (>35 foot commercial vessels fishing in Canada's EEZ) indicate that in 2005-2010, a high percentage of Northern and Spotted Wolffish were released alive. It is unknown why the percent alive upon release has significantly decreased for Northern Wolffish and Atlantic Wolffish since 2010 (DFO 2013). It must be noted that live release does not ensure post release survival.

Wolffish are captured incidentally by a wide variety of gear types in many different fisheries. With the exception of the Nordmore Grate in shrimp trawling, which excludes most wolffish greater than 15-20cm (Kulka and Simpson 2004), few other modifications to gear have

been identified or developed to prevent wolffish capture. Live release of wolffish remains the most effective method of potentially reducing fishing mortality.

3.2 Report on Schedule of Studies to Identify Critical Habitat

The Recovery Strategy for Northern Wolffish and Spotted Wolffish is currently being updated and will include critical habitat in the Gulf of St. Lawrence and Newfoundland and Labrador waters. Defining critical habitat for wolffish has been challenging due to the partial knowledge of basic biological processes, limitations on survey data and fishery reports, difficulty in making direct observations in the wild, lack of traditional knowledge, and disparity of spatial scales when gathering fish and habitat data. Using the best available knowledge, critical habitat has been identified in the Gulf of St. Lawrence based on the work by Dutil *et al.* (2013a,b), as well as in Newfoundland and Labrador waters based on Simpson *et al.* (2012). Potential threats to critical habitat have also been identified.

This work represents progress towards Recovery Objectives 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities; and 4: Promote wolffish population growth and recovery.

3.3 Management Activities

Bycatch mortality was identified by COSEWIC as a threat to wolffish. Mandatory release of Northern and Spotted Wolffish bycatch was implemented in 2003 and is a condition of license for most commercial fisheries. Northern and Spotted Wolffish must be released alive unless permitted under SARA. Atlantic Wolffish are retained and sold in some areas. Information on commercial catch and release is collected from several sources. Commercial fishermen fishing in Canada's EEZ report mandatory release of wolffish by species in SARA logbooks. However, these logbooks do not document all wolffish bycatch occurring in Canadian waters, nor do they reflect all fishing mortality that regularly occurs outside Canada's 200 Mile Limit. Fisheries Observers, which observe a small portion of the total fishery, also gather information on the capture and release of wolffish by species. However, NAFO landings remain unspeciated, and discards are not reported by member countries.

These activities represent progress in Recovery Objectives 3: Reduce the potential of wolffish population declines by mitigating human impacts; and 4: Promote wolffish population growth and recovery.

3.4 Stewardship/Education Activities

A variety of promotional items and information materials have been developed by DFO and others to help increase awareness of wolffish. These items include brochures, factsheets, posters, and DVDs and are distributed in a variety of ways including school visits, trade shows, and Ocean's Day events. Much of this information is also easily available to the public via the SARA Public Registry and DFO websites. Wolffish have also been included in Species at Risk products including SARA identification cards, portable displays, calendars, SARA art project/shows, school education kits aimed at grades 4 to 6, and various promotional items.

DFO and various non-government organizations (NGOs) have been engaging stakeholders such as fish harvesters and plant workers, as well as the general public, to educate and inform them about the status of the species. For example, DFO Fishery Officers, while on direct patrol as well as during various meetings, continue to educate fish harvesters on the importance of accurate recording and reporting of wolffish catches. The DVD, *Wolffish – A Balance of Life*[3], is another useful tool which introduces viewers to these species. It dispels many myths about wolffish and explains their important role in the ecosystem, while providing a fish harvester's view of the species.

Since 2002, education and stewardship programs have focused on mitigating wolffish threats. Fish harvesters are trained in wolffish identification and handling techniques through factsheets and a DVD that demonstrates the proper handling and release techniques for wolffish captured in various fisheries.

These activities represent progress in Recovery Objectives 3: Reduce the potential of wolffish population declines by mitigating human impacts; 4; Promote wolffish population growth and recovery; and 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations.

3.5 Summary of Progress Towards Recovery

Section 3.5 is included to report on the outcomes of performance measures or general approaches as listed in Section 2.2 of this document. As previously stated in Section 2.2, performance indicators were not identified in the original Recovery Strategy. Progress in research and monitoring activities, critical habitat, management activities, and stewardship and education were discussed previously in this section.

The Action Plan for Northern and Spotted Wolffish will be completed in 2013. This fulfills the requirement under SARA stating that an Action Plan must be developed once the Recovery Strategy is complete.

[3] Wolffish – A Balance of Life. Intervale Associates Inc. 2007

4. Recommendations

Please note that implementation of recommendations is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Based on knowledge accumulated to date, the recovery of wolffish species as stated in the Recovery Strategy is still considered feasible. The Recovery Strategy is presently being updated using the most up to date information and data available. However, the original Recovery Objectives are still relevant and realistic. Much progress has been made on Objectives 1 through 5, as set out in the Recovery Strategy, but further work is required to fully achieve all the objectives. At this time there is no need to shift priorities set for the various Recovery Strategy implementation activities.

Critical habitat has been identified for Northern and Spotted Wolffish and will be included in the updated Recovery Strategy. Large scale collecting of habitat data will continue through DFO RV surveys and other surveys, while a finer scale focus on habitat through acoustic tagging and telemetry, as well as direct observation using SCUBA and towed cameras, needs to be enhanced. There should also be an increased emphasis on collecting age and maturity data. Population and distribution objectives, BRP's and biomass targets must also be identified to fully achieve the Recovery Objectives. Therefore, ongoing research on distribution, abundance, population structure, and life history is planned for 2013 onwards.

Since it is likely that misreporting of wolffish is still occurring in some areas, public education and stewardship activities by DFO should be expanded. A review of observer reports and logbooks is needed to ensure consistency among observers and fish harvesters. In addition, a re-evaluation of allowable harm should also be completed. Bycatch reduction initiatives and other management and stewardship activities will continue.

The status of all three wolffish species in Canada was re-assessed by COSEWIC in November 2012. Although there are signs of population recovery, COSEWIC recommended that all designations remain unchanged. Therefore, under SARA, the status for Northern and Spotted Wolffish will remain as Threatened and the status for Atlantic Wolffish will remain as Special Concern.

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APPENDIX 1: Map of NAFO Divisions

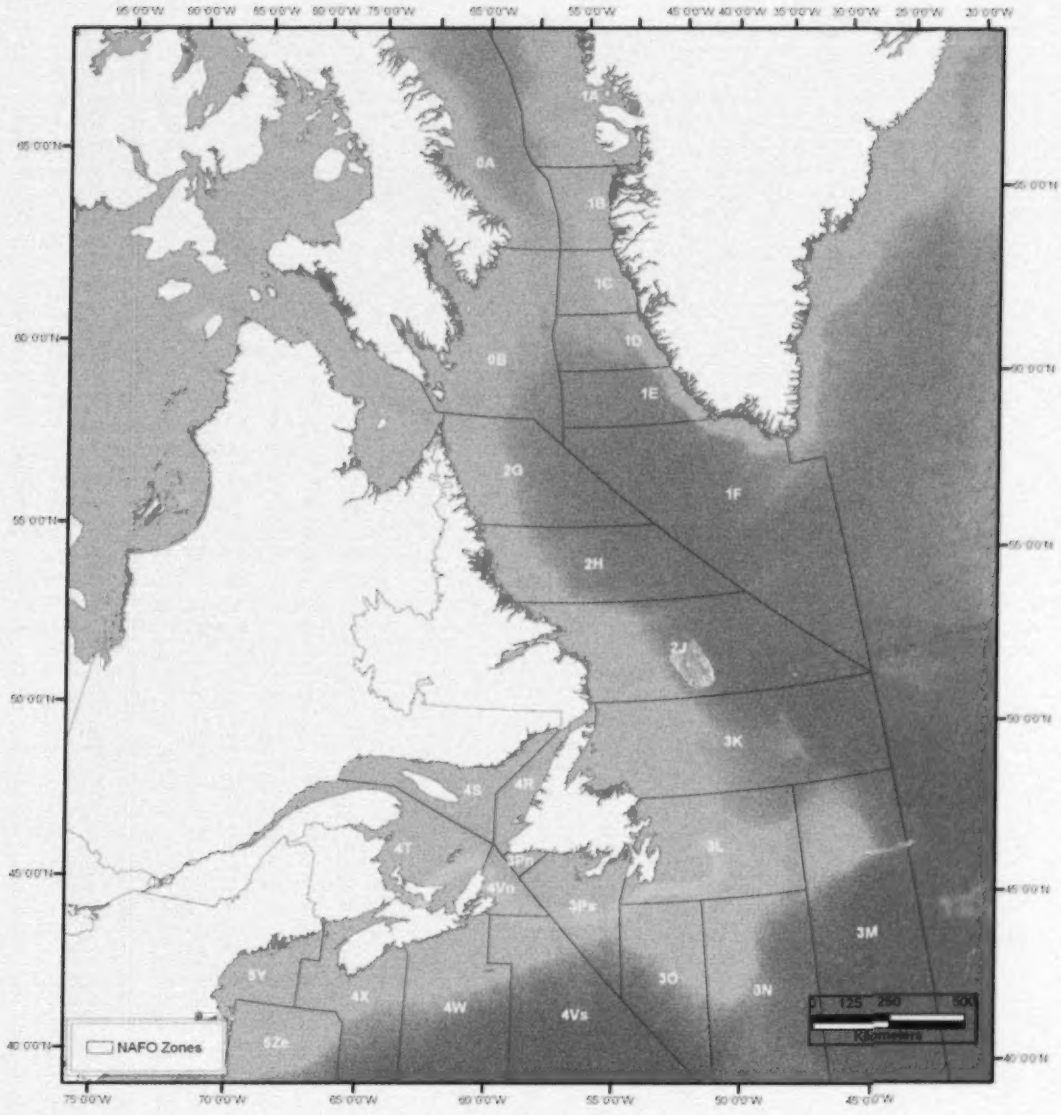

Figure 1: Map of NAFO Divisions